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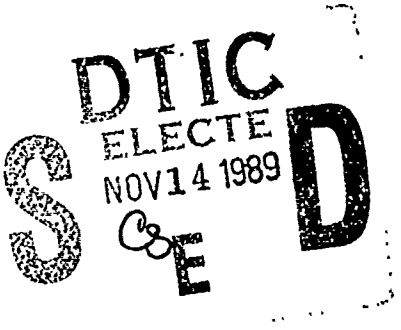
Danny Cohen

# Electronic Commerce





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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

*Computerized Commerce, or E-Commerce,* is commercial transaction *(e.g.,* buying and selling of goods and information ) via computers. The term applies particularly when computers perform a significant role beyond the tracking of details in support of human decisions.

Obviously, many tasks, essential to modern commercial life, should be re-assigned from people to computers. However, a *chicken and egg* dilemma retards change: Without supply there is no demand for such services, and without demand there is no supply. Once this dilemma is broken, the system should grow on a wave of positive feedback.

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This report describes many aspects of *E–Commerce* and its potential benefits: electronic gathering of needed pre–purchase information; E–CBD; methods for E–payments, including E–checks and E–stamps; distribution and delivery systems; E–advertisement; and Business Communication Protocols for computer/computer and for computer/man communication. Other topics include the potential problem of overselling, examples of *E–Commerce* start–up problems in the banking industry, and USC/ISI's Project *FAST*, an example of a project with the potential for breaking the dilemma, in a specific domain.

We believe that integration of all computerized systems., both inter– and intra–organizational, is the key to the success of *E–Commerce*. Without a unified public E–marketplace encouraging large numbers of sellers and buyers, and without accepted business communication protocols, small systems may proliferate independently and separately. We expect the Business Communication Protocol to be to *E–Commerce* what 4' 8½" was to the transportation infrastructure of the USA.

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# Electronic Commerce

## 1. Abstract

*Electronic Commerce*, or *E-Commerce*[1], is commercial transaction (*e.g.*, buying and selling of goods and information) via computers. The term applies particularly when computers perform a significant role beyond the tracking of details in support of human decisions.

Obviously, many tasks, essential to modern commercial life, should be re-assigned from people to computers. However, a *chicken and egg* dilemma retards change: Without supply there is no demand for such services, and without demand there is no supply. Once this dilemma is broken, the system should grow on a wave of positive feedback.

This report describes many aspects of *E-Commerce* and its potential benefits: electronic gathering of needed pre-purchase information; E-CBD[2]; methods for E-payments, including E-checks and E-stamps; distribution and delivery systems; E-advertisement; and Business Communication Protocols for computer/computer and for computer/man communication. Other topics include the potential problem of overselling, examples of *E-Commerce* start-up problems in the banking industry, and USC/ISI's Project *FAST*, an example of a project with the potential for breaking the dilemma, in a specific domain.

We believe that integration of all computerized systems, both inter- and intra-organizational, is the key to the success of *E-Commerce*. Without a unified public E-marketplace encouraging large numbers of sellers and buyers, and without accepted business communication protocols, small systems may proliferate independently and separately. We expect the Business Communication Protocol to be to *E-Commerce* what $4'\,8\frac{1}{2}''$ was to the transportation infrastructure of the United States[3].

A shorter version of this report was presented at IFIP'89[4].

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[1] Throughout this report "E–" is used as a shorthand notation for "Electronic–".

[2] The CBD is the *Commerce Business Daily*, published by the U.S. government.

[3] The U.S. standard railroad gauge is $4'\,8\frac{1}{2}''$, with ties $8'6''$ long.

[4] See "Computerized Commerce", in *Information Processing 89*, Proceedings of the IFIP 11th World Computer Congress, San Francisco, 1989, pp. 1095–1100. This paper is also available as an ISI reprint, ISI/RS-89-244, October 1989.

## 2. Introduction

In the future, most chores associated with routine commercial operations will be computerized to a greater extent than they are today. Since all steps of commerce, except the production, distribution, and delivery of physical goods, are forms of information manipulation, computers are ideally suited to handle them by using their capabilities for processing and communicating information.

More and more commerce will become *E-Commerce*, for three reasons. First, true *E-Commerce* would unify the E-marketplace and offer easy, uniform access to large numbers of suppliers and consumers, bringing new economies of scale. Second, that E-marketplace could reduce layers of middlemen. Third, computerized coordination would simplify multi-organizational transactions.

A great deal of the complexity of commercial transactions is in *risk management*, such as the coordination of letters of credit, shipping, payments, delivery, and insurance. All of these necessary steps require tight coordination among many organizations. In international trade, long distances, time zones, regulations, and language barriers add to the complexity. Codifying these webs of coordination and delegating them to computers can significantly reduce the complexity of tasks left to people.

Our conception of *E-Commerce* does not assume breathtaking breakthroughs in exotic technologies such as Neural Networks and Fiber Optic Communication. Instead, we assume that profit will continue to motivate the commercial world and that computing and communication powers will be about what they are today, possibly even at the same cost. We assume that communication will be at least as ubiquitous as it is today, that E-mail will grow in popularity, and that some scheme for authenticated communication and for E-checks will be adopted.

In the world of *E-Commerce*, computers could handle all advertising, shopping, negotiating, bargaining, and payment. Computers could make purchase decisions on "interchangeable" items, those with relatively short, and typically numerical descriptions. Airline tickets, groceries, mortgages, and integrated circuits are examples of items that computers could purchase by themselves, once asked. "Unique" items, such as art objects and family homes, will require human, rather than computerized, decision making.

All information products (*i.e.*, those without physical components) such as mailing lists, references to doctors, insurance policies, and various reservations are by definition interchangeable items. (Let it be clear: The references are interchangeable, not the doctors or insurance policies.)

For example, a person interested in buying a car will have some idea about the kind of car he wants (such as a sport or a luxury car) and possibly a preference in manufacturer and model. If he needs more information he should be able to review online the *Consumer*

*Reports* (or equivalent)[5]. Once he decides what to buy, some electronic form of the *Yellow Pages* is needed for deciding from whom to buy. Next, he sends a request for quotation (RFQ) message to a set of car dealers, telling them what he wants and requesting bids.

If the bids are identical in everything except price, the decision is probably simple, and may be left to computers. If the bids vary in, say, delivery schedule, optional equipment, and warranty and service policies, the decision might call for human help. Computers could be programmed to bargain according to various strategies. Once a decision is reached, with or without human help, the computers could transfer required funds, purchase required insurance, and handle registration.

If more and more purchasing moves to computerized systems over communication lines, how will customers get in touch with the physical goods? How will they test drive cars or listen, in person, to a hi-fi system before deciding what system to buy from the lowest bidder? Will this system introduce showrooms that demonstrate, but do not sell, items? Will these showrooms charge customers? manufacturers? both?

Many companies already offer computerized purchasing to the general public. Direct airline ticketing systems (without travel agents involved) are interesting examples. However, most of these systems are designed for the computerized vendor to conduct business with a human customer[6], at a dumb terminal[7]. In contrast, we want to computerize both. ATMs (Automatic Teller Machines) and computerized catalogs are computerized systems used in commerce, but not in *E-Commerce* as we see it, because both are parts of the man/machine interface and not of computer/computer interaction.

These examples, like tens of other *E-Commerce* systems, are independent of one another. We propose the creation of an E-marketplace in which all these systems work together.

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[5] Some suggest that the buyer be able to electronically simulate – "test drive" – the car, a common practice with aircraft. This idea is appealing, but not essential to *E-Commerce*.

[6] For example, the vendor's computer tells the customer's terminal what the price is, with no room for bargaining, which would take the fun out of buying cars.

[7] A dumb terminal is one with little or no computing and storage capability.

## 3. Pre-Purchase Information

The first phase of a typical purchase is deciding what to buy; the second is deciding where to buy it. Interchangeable items, such as road paint or nails, which can be precisely specified and do not have to be individually checked (or "felt"), are the easiest to buy. RFQs can be issued and sent to potential sellers.

If the RFQ does, indeed, completely specify the items, then the quotations may vary only in price and schedule. In this circumstance, evaluation functions of the price and schedule for selecting the best quotation are easy to define: cost only (but within a certain delivery schedule), or cost modified by the schedule (*e.g.,* a wait might be worthwhile if costs are expected to fall).

Even this simple scenario opens many interesting questions.

To whom should the RFQs be sent? We expect services to provide buyers with address lists (for E-mail, obviously) of potential vendors. How will such services be supported? Some might resemble the familiar *Yellow Pages*, in which vendors pay to provide information that is free to the buyers. Other services may be more selective and more specialized, or possibly, may provide a *Consumer Reports* type of evaluation. The higher the quality of the information (*e.g.,* the more specialized it is), the higher its cost might be.

Other services may distribute the RFQ directly to interested vendors. Still others may offer an E-CBD[8] that posts all RFQs, sends them to interested vendors, and can be scanned by vendors from anywhere.

All these services and many more could, and probably would, coexist. Their offerings need not be standardized.

Designers of electronic equipment could inquire about integrated circuits by generic description, such as "256Kbit EPROM" (or just "EPROM"), and receive specific information about available parts and their performance. Who would provide this information? Some of it would probably be available free from some vendors of electronic parts, and some would have to be bought from information services.

RFQ messages sent to vendors could take various forms, from highly structured, machine-readable format, such as the X12 standard, to human-readable formats close to plain English or to any other vernacular - we expect the human-readable format to prevail. In a sellers' market, sellers can dictate the format of the E-RFQ. However, in a normal free market, ordinary people will buy from vendors who can fill requests that are not "properly formatted", rather than from vendors who insist on the exact placement of commas and cannot handle orders written by people with imperfect skills. Consider, for example, the person who sends

[8] See Section 4 on E-CBD, below.

an RFQ to a dozen car dealers and receives ten bids and two messages chastising him for incorrectly specifying the date as "May" instead of "05". Chances are, these two dealers will not ring up a sale.

The same free market force will respond to languages in the market, such as Spanish in Southern California. The free format will not even require that these messages include a "Language Field" that must be set to a certain code to indicate Spanish. Messages will simply be written in Spanish, and vendors who cannot handle them will lose that business.

We propose X12H[9] as the designation of the still to be developed human-readable format for documents in support of *E-Commerce*. Computer programs that translate X12H between various languages will contribute much to international commerce.

Once buyers receive quotations from vendors, they can choose the best one. They may announce (through another message) to all sellers the intent to purchase these goods for that price, inviting them to underbid what was previously considered to be the best price. This could be done in any way, ranging from totally open communication to a one-on-one exchange, in a one-step or open-ended process. When performed by individuals, this process is called *bargaining*. When performed by large organizations, such as the government, it is dignified by the term *negotiation*.

In a buyers' market, bargaining/negotiation can take place. A sellers' market can reverse this process. Sellers may announce to all buyers the intent to sell goods for a certain price, inviting them to overbid what was previously considered the best price. This process – the opposite of bargaining – is called an *auction*. It too, can be one-step or open-ended and can be done in any way from an open announce[illegible] to a one-on-one exchange.

The scenario above requires many commercial entities to be able to send and receive E-mail. Fast response to such E-mail would be very advantageous. We expect larger sellers to handle their E-mail online, responding quickly (hence, automatically) to the requests of their customers. Smaller organizations, such as individual buyers with home PCs[10], may instead have offline mailboxes and respond to their E-mail more slowly.

With time, it will become the norm among large organizations to have RFQs for standard items open just long enough for computers to check inventories and to reply in a few minutes or hours, but not days. Once a few suppliers start such an online service, and attract many buyers, more and more vendors will do business via online E-mail.

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[9] Section 13 on Business Communication Protocols discusses X12H in more detail.

[10] Throughout this report, PC (or "personal computer") means a generic personal computer, regardless of make and model. It is assumed to have computing, storage, and communication capabilities.

## 4. E-CBD

To encourage competition and give smaller suppliers a chance, the U.S. government publishes all RFQs it issues in the *Commerce Business Daily* (CBD). In practice, however, not all RFQs appear there.

The CBD is printed on paper and is sold to anyone who wants it.

Because the CDB is offline – that is, on paper – it takes awhile from the time a government agency sends an RFQ to the CBD until it is actually printed there. There are services that put the CBD online and, for a fee, enable their customers to find selected announcements by matching keywords. The CBD could be based entirely on E-mail, eliminating the time delay between the release of the RFQ by the government agency and its actual publication in the CBD.

Such a CBD could be either *passive* or *active*. A passive CBD posts information and waits for users to find it. An active one sends the users, via E-mail, any information that may be of interest to them, as defined according to user-provided algorithms (*e.g.,* by a Boolean expression of keyword matches).

Users would subscribe to such a service by providing the filtering algorithm, specifying how the information is to be forwarded to them (*e.g.,* by providing an E-mail address), and paying for the service. The fee should reflect the quantity and the delivery mode of the information sent to them. Users could ask for that information to be E-mailed to them or, if they chose not to subscribe to any E-mail system, could request that the active CBD use online-to-offline facilities, such as E-mail-to-FAX[11] or E-mail-to-paper features.

This service would be very valuable to small companies (*e.g.,* machine shops that manufacture custom parts) that would not scan the CBD daily because of the low average number of announcements relevant to them. Such an E-CBD would open government procurement to many more potential bidders, especially small businesses. Once the CBD and enough vendors are online, the government could drastically reduce the period for RFQs, especially for standard parts, and thus reduce procurement delays. This would have a very favorable impact on inventory levels and would reduce the high cost of maintaining large inventories.

[11] The standard facsimile service.

## 5. E-Payments

The idea of E-payments is not new. It has been suggested in numerous articles. Most of the proposed schemes are based on digital signatures[12] that cannot be forged. Typically these schemes are based on Public Key Encryption[13]. Digital signatures could be used for authentication, in general, and for payments in particular.

Let's assume accepted schemes for digital signatures and for E-checks. The E-check scheme would not necessarily be based on public key encryption. E-checks could be based on specific encryption keys between individuals (and/or organizations) and their banks and on inter-bank keys.

An *E-check* is a digital record that effects transfer of funds from the account of its signator in a certain bank to another's designated account, possibly at another bank. The banks guarantee that this transaction will occur only once, even if several duplicates of that record are presented.

With public keys, an E-check may be issued by one party to another without involving any third party in the loop. For offline transactions the few seconds' or minutes' delay required for the four-party handshake with the banks is insignificant.

The following is a simple example of an E-checking scheme based on public key encryption. It assumes that public key encryption systems are accepted and that a financial infrastructure exists to support electronic transactions. Under this scheme $A$ uses his secret key to give $\$S$ to $B$, by creating the following decrypted record:

" $A$ gives $\$S$ to $B$, at time $T$, Check $\#R_A$, Receipt $\#R_B$ "

Anyone may use $A$'s *public key* to decrypt and verify this record.

$B$ (and only $B$, no third-party endorsement is allowed) receives credit for $\$S$ from the central E-bank (E-clearinghouse?) upon presenting that record. (For extra protection, this record may also include a receipt by B, possibly encoded by B's secret key.) It is the E-bank's responsibility to eliminate multiple presentations of the same record. The E-bank does not have to be a single, monolithic entity. It could be a cooperative distributed among many banks.

Without public keys, a four-party handshake – between A and $BANK_A$, between $BANK_A$ and $BANK_B$, and between $BANK_B$ and B – might be necessary. This method has the

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[12] See, for example, *A Method for Obtaining Digital Signatures and Public-Key Cryptosystems*, by Rivest, Shamir, and Adleman, MIT/LCS/TM-82, April 1977; and *Digital Signatures and Public-Key Functions as Intractable as Factorization*, by Rabin, MIT/LCS/TR-212, January 1979.

[13] A large bibliography on the subject can be found in "The First Ten Years of Public-Key Cryptography", by Diffie, *Proceedings of the IEEE*, vol. 76, no. 5, May 1988.

disadvantage of requiring communication in order to complete the transaction. Its advantage is that by the time the transaction is complete (within a few seconds or minutes, depending on the communication technology), the banks have assured the receiver that the E-check is good.

Any scheme adopted for E-checks must thwart alteration or duplication by the receiver and denial by the signator of the check.

Other important features of the E-check are traceability and the ability to cancel fraudulent transactions. If an E-check is forged, for example, it should be possible to cancel the transaction, which cannot be done with cash payment. This may impose additional responsibility on banks. On the other hand, it reduces dependency on the encryption scheme, and helps make the system acceptable to the marketplace and the public.

E-checks could be made a part of all commercial transactions that require any payment. Parties who have never met must be able to create an online payment without prior, offline, paper-based arrangements, just as people can stop at most stores and buy goods with cash, checks, or credit cards without first going through the process required to get the store's own credit card.

For example, a user is told by his favorite information service that further information on a subject is available only from another service, and the user (or his computer) is willing to pay for that information from the second service. Most systems today would require him to manually contact that service, sign a contract, p ·ibly issue a Purchase Order, and so on, before he could get the information he seeks. It would be better to be able to issue an E-check to pay for the service, and eliminate the lengthy process for establishing a long-term relationship with that service.

When E-checks become popular, many new services will become available. Sports fans will be able to buy scores of favorite teams, just as they can buy scores, jokes, and prayers today via a 976[14] phone call. Fishing reports, ski reports, reference lookup, entries from an encyclopedia (or a dictionary), lyrics of a favorite hit, astrological forecasts, airline schedules (à la the *OAG*[15]), and weather reports are just a few examples of information that could be electronically available for a fee. Similarly, other computing-based (rather than information-retrieval) services will become available, too, such as psychoanalytical services

[14] A little-known fact is that 976 handles also several "clean" (*i.e.*, not sex related) calls, in addition to the "dirty" calls that made it famous. A new exchange (500?) will probably be introduced for "clean" calls, leaving 976 for "dirty" calls, which could be disabled by customers on demand as mandated by several proposed laws.

[15] The Official Airline Guide.

à la Eliza), tax preparation according to the latest tax laws, document editing, games, and entertainment. In addition, many new tele-procurement systems will be introduced – tickets for travel, theater, and sporting events[16], hotel reservations, catalog sales, loans, mortgages, and insurance policies, to name a few.

Without ways of collecting revenue for these services, they will never get started. However, once the payment collection problem is solved, only our imaginations will limit them. We propose E-checks as one possible solution.

With E-checks, any user will be able to purchase anything available in the E-marketplace, directly, without a "registration" process (as with services such as The Source, CompuServe, and Prodigy). These purchasing services should be modeled on the typical retail store – available to anyone, anytime, on a "pay as you go" basis – rather than on "membership stores" that serve only pre-registered users.

To make E-payments as popular as credit cards, computer terminals should be as accessible as TRW terminals[17] are today. However, the present schemes of passwords and PINs (Personal Identification Numbers) must go; more secure authentication is needed. Since these schemes cannot depend on secret information being communicated through channels that may be compromised (such as phone lines or any computer that belongs to others), they would depend on local processing, as in *challenge/response* schemes. This suggests personal identification cards, probably in the size and shape of credit cards, which store secret access codes (passwords, PINs, *etc.*) and also contain a processor that can participate in active security schemes[18].

Such means are critical for a truly universal and ubiquitous secure communication infrastructure.

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[16] It seems that the importance of paper tickets is exaggerated. After the ticket is sold (*i.e.*, the reservation is made and confirmed with payment), the customer should be able to get a paper record, if so desired, from a machine at the airport (or the theater) after identifying himself with, say, a credit card. This record could also serve as an airline boarding pass.

[17] TRW terminals are used throughout the United States for instant credit check for payments by checks and credit cards.

[18] These cards would require their own passwords, so they would not function in the wrong hands.

## 6. Distribution and Delivery

> For present purposes, *"distribution"* means the conversion of large-volume sales (wholesale) into a large number of smaller volume sales (retail). *"Delivery"* refers to the actual transportation of physical goods to end users.

The entire distribution infrastructure exists mainly for handling large quantities of sales, each involving small quantities of goods. The smaller a purchase is, the more middlemen participate in the process. The distribution infrastructure provides the "fanout" required for a few providers to reach a large number of customers.

The level of automation suggested by *E-Commerce* will greatly reduce the need for the distribution infrastructure and may eliminate many of the middlemen. This will be more pronounced in the case of items with no physical components – information, insurance, loans and mortgages, etc. – and least in the case of unique physical items. Once information dissemination (*e.g.,* advertisement), paperwork (including quotations and orders), and the collection of funds are completely automated, even the biggest manufacturers will be willing to deal directly with the smallest customers — eliminating much of the distribution infrastructure.

This effect will be most pronounced where shipping and packaging are less dependent on the volume shipped. Completely automated facilities for shipping and packaging would greatly reduce the need for distributors. Machine-readable shipping labels (and shipping manifests, where needed) would help the modern shippers (à la UPS and Federal Express[19]) reduce shipping cost.

Old-fashioned distributors, especially those with shelf space for the public to see and inspect products, will still be required in some cases, even if totally eliminated in others. Among the survivors would be distributors of products with a packaging and shipping cost structure that is not reasonable for direct shipping and packaging of low-volume orders. Customers will continue to desire to inspect and even feel certain unique items like jewelry, art objects, and furniture, and also to try on clothing. They will continue to browse in bookstores and purchase books they never intended to buy when they entered the store. Distributers with physical showrooms will always cater to the impulse buyer.

Many supermarket items could be automatically procured[20] according to standard procedures, while others have to be seen and felt. Will supermarkets be willing to reduce their size and to support direct delivery from their warehouses to homes?

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[19] United Parcel Service (UPS) is the most popular package delivery service in the U.S., more popular even than the similar service offered by the postal services of the U.S. government. Federal Express is a private service that specializes in fast delivery of letters and small packages.

[20] Question: Should the refrigerator and the pantry monitor their inventories and automatically order replenishments? Could this be done without squeezing the fruits and vegetables?

As *E-Commerce* spreads to individual customers home delivery will increase greatly. The delivery infrastructure[21] may have to develop to accommodate that. At present, no standard arrangements exit for homes to accept packages during most of the normal business hours, when no one is at home. Also, the "last mile" devours a significant fraction of the total delivery cost. That could be reduced in several ways. UPS (or equivalent) could store all packages for a certain customer and deliver all of them together. Hence, UPS would not handle all packages online, but instead would provide a *"store-and-forward"* service. This may be reasonable when all the packages are handled automatically under computer control and will probably reduce cost of delivery.

In summary, the fundamental issue is whether the distribution system is essential or incidental to the entire marketplace system. For those cases where it is only incidental, *E-Commerce* may eliminate the need for it.

The quality of products (*e.g.,* cars and TV sets) does not depend on how many middlemen are involved in getting the product from its original manufacturer to the final customer — but the price does, often very significantly. What value do the distributers add? They disseminate information, handle paperwork associated with small-volume sales (including the fund collection), provide a place for physical inspection, share risk (by buying the goods and assuming the loss if the product does not sell), and package and transport small quantities.

With automation, all information about products could be directly disseminated from the original manufacturers to the final customers. Similarly, paperwork associated with all sales (including the fund collection) would be computerized – hence, distributers whose only function is information handling (*e.g.,* insurance brokers) could lose a significant share of their business to *E-Commerce.* However, distributers who give customers the opportunity to inspect physical items – both interchangeable ones, such as cars for test driving or hi-fi systems for listening evaluation, and, especially, unique ones such as art objects or jewelry – may be affected differently by *E-Commerce.* Distributers who share risk with the original manufacturers may be affected even less by *E-Commerce.*

Where there is an inherent economy of scale in packaging and transportation, it may always be advantageous to have some distribution organization in place.

[21] Appendix B on *Package-Switching Technology* may provide some ideas about the delivery infrastructure.

## 7. E-Advertisement

E-advertisement is carried electronically through E-messages, rather than by local electronic means such as E-catalogs.

Junk mail (J-mail) advertisement and TV commercials gave advertising a bad name, worsened by automatic calling machines and J-FAX. However, advertising has an important role in commerce. It helps users create their own mailing lists, and it creates the market for many items by educating customers about new technologies, products, and services.

For example, general books (like literature and unlike reference books) are bought "because they are there", as a kind of impulse buying. Advertising in its many forms, including book-reviews and open shelves for browsing, tells readers about these books and triggers their desire to read them.

Product announcements and data-sheets, for precise product specifications, are a welcome form of advertisement. So are price lists, manufacturers' coding schemes, and discount schedules. Standards should be developed for all of these, within the BCP[22] framework, to support automatic processing of such E-messages and to integrate them into other systems – *e.g.,* data sheets of ICs into computer-aided design (CAD) systems. For example, as more organizations advertise through such E-messages, more organizations will implement the software required to process them. Dually, as more organizations can process them, more organizations will send them. The positive feedback of usage will cause the system to grow, once the *chicken and egg* dilemma is broken.

One possible form of E-advertisement is the E-message that tells of the existence of certain products and services. Another is E-messages that provide E-addresses for buying these products and services. Yet another is a response for an RFQ saying: "We can deliver a better product than the one you asked for. It costs only $\$S$".

Madison Avenue has created a science, or at least a technology, to make it difficult to filter unwanted advertisements from valued information. Many FAX machines, already victims of this technology, are tied up for long periods by incoming J-mail and J-advertisements. It is encouraging that a few states have already outlawed J-FAX.

The success of *E-Commerce* may also create a new market for "junk mailers" and advertisers. It may take awhile to recognize the problem and to create the counter-programs.

We expect an interesting intellectual warfare to break out between junk E-advertisers and those who devise and install Electronic Counter Measures (ECM) against the junk E-advertisement. In all likelihood, ECM will be followed by Electronic Counter Counter Measures (ECCM), and so on – all to the delight of those selling the communication services.

[22] See Section 13 about Business Communication Protocols (BCP).

If creating and distributing thousands of RFQs for each item gets to be too easy, we may face another problem. "Junk RFQs" and "junk quotations" could overload the system to the point that the real ones could be ignored or lost. Fast communication and fast automated processing may alleviate the problem.

In the electronic age, the E-advertisement has the potential of being effective without being bothersome. Let's hope that this will be the case.

## 8. Integration

The greatest impact of *E-Commerce* on the function of society will be through its integration with the internal automation of its participants. *E-Commerce* cannot reach its potential as a stand-alone concept. It implies automation of many other aspects of the entire commercial/industrial society, because *E-Commerce* addresses mainly *inter*-organizational transactions. For them to be fully effective, the *intra*-organizational transactions must also be computerized and streamlined. Local (*i.e.,* internal) automation and *E-Commerce* should develop together.

Consider, for example, manufacturing organizations. *E-Commerce* will be most effective only when the entire production process is fully automated. By automation we mean the computerized handling of information, rather than digitally controlled machinery (*e.g.,* robotics) for production and material handling. This automation will include the schedule of delivering finished products, the inventory control, and the tracking of raw material and of partially finished products[23]. Automation will support Just-In-Time (JIT) manufacturing, which minimizes inventory and storage costs. For that to be fully effective, the automation must cover all aspects of production, from design information to projected deliveries and shipping. *E-Commerce* should provide the JIT-procurement needed to support the JIT-manufacturing.

This integration is not limited to large-scale organizations. For example, computer-based calendar programs could automatically arrange all required travel inferred from entries in a calendar, and provide feedback (such as "you do not really want to travel to Chicago on the day before Christmas. All flights there are already over-booked...").

Another important form of integration appears in transactions with more than two participants. International purchasing provides many examples of such transactions. Typically, these require some form of trust, such as credit and delayed payment, and risk management. In such transactions, shippers, bankers (who issue letters of credit, for example), insurers, and others are involved, in addition to the buyer and the seller. Coordination among all of them is intellectually simple but complex in practice, very time consuming, and hence expensive. *E-Commerce* can streamline this complexity and the handling of such transactions.

In another example of integration, a user's programs, on his own computer, could read online stock market information, apply *any* algorithm selected by the user, and initiate various stock transactions – without relying solely on algorithms available through stock brokers. Similarly, computer-aided design (CAD) systems will automatically provide the total cost of all parts involved in a design and alert the designer about parts (and other raw materials) of questionable availability. These CAD systems will automatically contact remote databases to find better alternatives.

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[23] One cannot and should not expect information automation and production automation to be totally decoupled. Inventory control and automated material handling (*e.g.,* transportation between stations) should be closely coupled.

## 9. Why It Is So Hard (and Slow) to Get There from Here

If *E-Commerce* is so good, why isn't it here?

*E-Commerce* has a great many advantages, but we must remember that many hurdles stand on the road to the needed environment and infrastructure.

First is the *chicken and egg* dilemma: Without supply there is no demand for such services, and without demand there is no supply. *E-Commerce*, like the telephone, grows in utility with the number of participants. It was not easy to sell the first telephone, and it is not easy to sell *E-Commerce*. The slow rate of E-mail acceptance by the general population offers important lessons, including one on the extent of that *chicken and egg* dilemma.

Many of the hurdles are forms of inertia characterized by the attitude, "This is not the way we do business". The main problems come from human attitudes and regulations.

First, many who would benefit from *E-Commerce*, from individuals at home to buyers in large organizations, are still not used to the "culture" of computer terminals and computer communication networks or even word processing. For them, *E-Commerce* represents culture shock. Even though many applications depend on the use of this technology, they find it too much of a barrier when measured one application at a time. Those who manage to make the initial transition typically find it easy to transfer their skills to new applications.

While well-designed *E-Commerce* systems should provide an adequate audit trail, it may differ from the traditional paper trail. This difference may frighten some managers.

The procurement process is rich in regulations, from the common Generally Accepted Accounting Procedures (GAAP) to IRS regulations and DoD-approved procurement procedures. The larger the organization is, the more regulations and procedures it has to meet.

Most of these regulations are accounting oriented. Some of them specify such items as approved vendor lists and quality-control procedures to be incorporated into the procurement process. To succeed, *E-Commerce* must comply with all regulations and procedures.

Another source of resistance to *E-Commerce* is the tradition of salesmen treating buyers to lunches and free souvenirs (such as a gold pen with the seller's logo). It is interesting that these lunches are justified by both parties as means to get better deals. Again, *E-Commerce* should reduce the need for much of the existing distribution infrastructure. Therefore, we could expect that infrastructure, including salesmen and buyers for large organizations, to feel threatened and to resist it.

Last, but not least, is the danger of overdoing *E-Commerce*. Overzealous programmers may try to eliminate all human involvement in procurement decision making, and that would be a grave mistake; some human involvement and judgment will always be needed for some transactions. Deciding where human involvement is needed calls for intelligence and judgment.

## 10. E-Banking (and More about Why It Is So Hard and Slow to Get There)

We distinguish what we call E-banking from Electronic Funds Transfer. EFT, used extensively among many banks both domestically and internationally, is based on private arrangements among banks that trust one another. It is not open to the general public.

Many banks in the United States, such as CitiBank in the East and Bank of America in the West, allow customers to call in from their terminals (over phone lines, typically of up to 2,400 baud) to perform such elementary banking transactions as inquiries, transfers of funds between the customer's accounts, and payment of bills (*e.g.,* phone and credit cards) to companies with arrangements with that bank. A few banks also allow purchase and sale of stocks in a similar manner.

This service has not been enthusiastically received by consumers. The bill-payment service has not been accepted because it is too bothersome for the people at whom E-banking is targeted. They must make a special phone call to the bank – as opposed to just "address" the bank on an already open network connection – to perform the log-in procedure for that bank. Then they can use the service to pay only some – not all – of the bills[24] they received on paper. Note that E-invoices could be paid by one key stroke, unlike paper invoices, which require much more typing, if only to identify who is to be paid, and how much.

A network connection, rather than telephone point-to-point connections, allows not only ease of switching between various destinations, but also the simultaneous connection to more than one address, as is necessary for some computer-based applications.

Incidentally, an interesting question arises about the future ubiquitous network of users. Should we assume that users have only simple dumb terminals? Or should we assume at least the computing and storage capabilities of a personal computer? We prefer to assume the latter, or at least a mix of the two, and we hope that many services will be offered for computers, not just for dumb terminals. In the past, most systems that were offered to the public assumed only dumb terminals. Modern ones in the U.S., such as the recent Prodigy[25], assume personal computers. We like this trend.

However, just assuming that users have computers, rather than dumb terminals, is not enough for *E-Commerce* if proprietary software is required for access to the services. True *E-Commerce* demands open and public protocols and data formats, so that anyone may develop and use new software (as long as it complies with the established standards, obviously).

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[24] Several banks allow paying *all* bills, even for payees with whom the bank has no prior arrangements. The user types in the mailing address of the recipient and the banks actually mail a paper check to that address. However, many users find this more work on their part than using the pre-addressed envelopes enclosed with most bills.

[25] Prodigy is a system offered by Sears & Roebuck and IBM. Registered customers can make airline reservations, inquire about weather, and so on, through their home computers (which, incidentally, must be IBM-compatible).

The few banks that offer E-banking assume that users interact manually, from dumb terminals, with the computers of the banks. Hence, they limit users to simple manual transactions unsupported by automatic programmed applications. One such program could accept an invoice over E-mail, verify it against the user's own databases, and instruct[26] the bank to pay that invoice. Or a program could "listen" to stock market reports and buy and sell stock according to the user's own algorithms.

Security is not a big issue. Even the lowest level security scheme of passwords, transmitted in the clear (and easy to intercept) is enough, because payments are made only to known accounts and fraudulent payments can be traced and reversed.

The situation would improve if many, and eventually all, companies ("billers") would issue E-invoices (*e.g.,* through E-mail) that are E-payable (*i.e.,* payable through E-banking). For that, companies need not convert all of their accounts payable to E-invoicing simultaneously. It would suffice to provide E-invoices only to customers who ask for them, and to provide E-addresses[27]. After the initial investment in software, E-payments of E-invoices would cut costs for the payees by reducing the manual labor of paper billing and paper collection and by reducing errors associated with them. A little-known fact is that in 1985, MCI-Mail tried to introduce a system of E-invoices and E-payments, but the banks decided the market was too small at that time.

Companies issuing E-invoices should use X12H for all information needed for E-payments. Exclusive use of X12H would make it easier for users to get the software required for E-payments of E-invoices. Note that X12 invoices do not have the means to provide instructions needed for E-payments. X12H invoices will have such means.

E-banking, E-invoicing, and E-payments will not be really popular as long as only a few banks offer E-banking, few (if any) companies issue E-invoices, and only a few companies agree to be E-paid. Failure is certain if all the organizations are offering the services in incompatible formats. The sooner more banks and companies offer unified E-invoices and E-payments, the sooner the general public will accept these services.

We suggest that the best way to proceed is to introduce the appropriate X12H and promote its acceptance in the marketplace by distributing X12H software at a nominal cost, say, slightly above the reproduction and distribution cost of the software for handling E-banking, E-invoicing, and E-payments. This software should be prepared for the five or so most popular home computers and in concert with efforts to expand the utility of interconnected home computers (*e.g.,* for E-mail). Once this is done, the *chicken and egg* dilemma will be broken.

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[26] Possibly, but not necessarily, with some manual approval.

[27] These E-addresses may be the customer's own or his E-bank's.

Clearly, such progress will eventually benefit all involved parties and the country in general. But who is willing to make the initial investment? It is a sad commentary on our society, in the United States, that no private body is in position to make such investments. (We sincerely hope that we are wrong in this pessimistic assessment!) Some foundation may find this a worthy cause. Our last hope is that our government will be wise enough to invest in such an effort, as other governments have done[28].

Once E-banking starts gaining real popularity, the software industry will introduce the next tier of programs, such as those that automatically capture E-banking transactions in a form most suitable for preparing income-tax returns or check for medical expenses and automatically issue the proper insurance claims and track payments for these claims.

[28] The French Telephone monopoly invested 1.3B$ in Minitel (from which users received free terminals and keyboards, worth about $160); in West Germany the government has invested (as of October 1988) 450M$ in their Bildschirmtext system. *New York Times*, November 8, 1988.

## 11. Overselling

Overselling seems to be the norm with new technologies. Making promises [illegible]ery likely to be kept may be a great short-term tactic, but it cannot succeed in the long-term strategy – though pushers of certain technologies have managed to delay the effect of the "you cannot fool all the people all the time" rule.

An example of overselling is this November 8, 1988, headline in the *New York Times* Science section: "New Space Beacons [GPS] Replace the Compass". The suggestion that in the future ships will not carry compasses is unrealistic and does not enhance the credibility of GPS technology, as good as it is.

Isn't it equally unrealistic to expect electronics to replace all forms of paper – remember the *paperless society*? – including newspapers and books? or to replace live theater, or direct human contact?

Except for a very specific kind of news (*e.g.*, on election day), the general public prefers to browse through paper, not electronic!, newspapers – in spite of the effort to make the news available through Minitel, for example.

Systems such as Videotex, Minitel (France), Prestel (UK), and Bildschirmtext (West Germany) were expected to bring about a high-tech communications revolution. None did. This is not a failure of any of these systems, just a result of overselling and unrealistic expectations.

A third of all Minitel calls are for white-pages directory assistance. A large percent of the other calls are for direct user-to-user communication. Minitel is not used as it was expected to be used, but neither is the ARPANET[29].

Similarly, E-mail in the United States did not meet the high expectations of the many companies that offer this service to the public. We hope that the slow start of these services[30] will be measured against overselling and that overselling will not cause many of the offerings to be cut.

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[29] The ARPANET was envisioned to support *resource sharing*, not E-mail, its major use today.

[30] According to an October 1988 report by the West German Federal Accounting Office, Bildschirmtext had only 120,000 subscribers after an investment of 450M$.

## 12. FAST and MOSIS

Under sponsorship of the Defense Advanced Research Projects Agency of the U.S. government, USC/ISI has started the *FAST* project to create an *automated broker* for standard electronic parts. Users routinely send E-mail messages to *FAST* about standard electronic parts, and then purchase them.

Except for initial sign-up, the system functions entirely via E-mail. Users of *FAST* request information and quotations, inquire about alternative equivalent parts, order them, are invoiced, and inquire about status of orders, all via E-mail. When completed, *FAST* will handle all of these requests automatically, with no involvement unless it is specifically requested.

*FAST* has established online connections with several distributors of electronic parts and has online connections to various databases containing information about them.

The *FAST* user community includes organizations ranging from universities to defense contractors to various arms of the U.S. government. In its first two years of operation, *FAST* has helped many users procure parts from many vendors. In all cases, *FAST* provided faster service than traditional manual procedures. In most cases, *FAST* also managed to find sources at a lower cost and/or faster availability than its users were able to find by themselves.

The *FAST* project encourages first use of the service for quotations and information in parallel with traditional manual procurement procedures. Users are told to turn to *FAST* for orders only when it can improve the cost and/or the delivery schedule.

For several years, USC/ISI has operated a *"Silicon Broker"* system called *MOSIS*[31]. It gives researchers all over the United States the ability to submit, via E-mail, designs in digital form for printed circuit boards (PCBs) and VLSI integrated circuits (ICs) in various technologies (*e.g.,* CMOS) and geometries (*e.g.,* 1.0$\mu$). The VLSI designs are then fabricated into silicon wafers that are tested, packaged, and delivered via UPS within a few weeks. Some consider *MOSIS* a model for *E-Commerce.*

The main difference between *MOSIS* and *FAST* is that *MOSIS* users must provide a complete description of the IC or PCB, whereas users of *FAST* have only to provide a pointer, a catalog number, to a part. A specification of a part given to *MOSIS* may require hundreds of kilobytes (in CIF[32]); in contrast, the specification given to *FAST* typically does not exceed a single line.

*FAST* can break the *chicken and egg* dilemma by targeting itself first to a community that is already a routine user of E-mail in general and the *MOSIS* service in particular. For this

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[31] More about *MOSIS* may be found in "MOSIS - The ARPA Silicon Broker", by Cohen and Lewicki, in *Proceedings of the 2nd Caltech Conference on VLSI*, January 1981, pp. 29–44.

[32] The Caltech Intermediate Form, used to define digitally the geometry of integrated circuits. CIF is used as the main interface of the VLSI designers to the fabrication process.

community, no culture shock is associated with the use of E-mail to order electronic parts. *MOSIS* users routinely send messages that result in chips and boards being delivered to them. Since most *MOSIS* users build electronic systems around their custom chips, they typically require the services that *FAST* provides.

In establishing the *FAST* system, project researchers addressed problems resulting from the lack of common interfaces to the computerized systems of the vendors and from users' lack of experience with computerized purchasing.

Some vendors have reached what they consider to be complete automation of their systems. They allow selected, typically high-volume, customers to interact directly with their inventory computers, to inquire about availability and cost and to place orders. Unfortunately, most of these efforts have been aimed at supporting remote users at terminals rather than remote computers. Many of the features designed to make the human interface smoother and nicer have the side effect of making the same interface more difficult for computers to handle automatically.

Both *FAST* and *MOSIS* deal with users with high levels of computerization (*e.g.,* CAD systems) but without experience with computerized purchasing. These users interface with *FAST* and *MOSIS* through human-readable protocols (on top of E-mail), which *FAST* and *MOSIS* programs process automatically. Only some of the users have programs to generate these E-messages.

The computerization of the *FAST* and *MOSIS* interfaces with those of their vendors is slowed by the existing "culture" of these vendors. Some use X12, some use private protocols. In others, *FAST* simulates a terminal connection. *MOSIS* has pioneered the computerization of several parts of the vendor interface.

*FAST* is an environment in which the seeds of *E-Commerce* can sprout. It serves its users/customers and educates its vendors about *E-Commerce*. More important, it provides a testbed for developing procedures for organizations to use as they participate in *E-Commerce*.

The ultimate success of *FAST* would be an environment in which users can get all required services directly from vendors. In such an environment, there would be no need for *FAST* or for any other middleman. *FAST* is sincerely working toward this goal.

*FAST* provides a single, unified user interface to a variety of vendors, whose unique interfaces are not suited to the environments available to the users. It also simplifies paperwork; in *FAST* one signed purchase order (P/O) serves all vendors, instead of an individual P/O for each vendor. Both of these benefits are incidental, not essential, and would not exist in an ideally computerized world, where individual users' workstations would be able to issue RFQs directly to all possible vendors – even those unknown to the user – and then automatically assemble, prioritize, and perhaps even choose from the responses.

On the other hand, *FAST*, as a good broker, provides quantity discount (or faster service, more attention, or whatever) to its users by bundling orders together. The notion of "quantity discount" is fundamental because it is economically viable in a world with competing suppliers. However, the value of the quantity discount has to be measured against the operating cost of the broker. Only economic analysis too detailed for this report could measure the economic viability of *FAST* in the ideally computerized world.

## 13. Business Communication Protocols

Paul Baran was the first to propose *Packet Switching*, in a series of RAND reports entitled *On Distributed Communication.* Baran was one of the first to envision a business communication protocol, which he described in an article in *Public Interest* in 1965. In this article, he described a future in which companies are equipped with online computers and communication networks. These allow the inventory control system in one company to notify its buying clerk about the need to purchase a certain product. The clerk then types a message into a terminal connected to a communication network that delivers that message to a sales clerk at another company. The sales clerk then enters this information into his company's computer, causing the sale to take place.

John McCarthy, of Stanford, suggested eliminating the need for these two clerks by developing means for computers in different companies to communicate directly. McCarthy wrote: "Eliminating both clerks by having the computers speak directly to each other was not mentioned [in Baran's paper]. Perhaps the author felt that he was already straining the credulity of his audience." McCarthy proposed the "*Common Business Communication Language*" (CBCL)[33] for direct, business-related communications among computers of different companies.

Several companies that conduct a large volume of frequent business with each other recognized the need for such a protocol. They ignored McCarthy's visionary ideas and sought to solve their immediate problem by means of "*Electronic Data Interchange*" (EDI), conventions for the exchange of business-related information.

The X12 format is the most widely used form of EDI. It is orchestrated and managed by ANSI's ASC-X12 (Accredited Standards Committee X12). A large number of organizations participate in the X12 activity; it has developed massive inertia.

The following properties of X12 are of special interest:

* X12 is not self-defining.
* X12 is rigidly structured, not open, not extensible, and non-flexible.
* The use of X12 is based on private, bilateral (rather than universal) agreements.
* X12 is machine processable, not human readable.

[33] McCarthy, John: "Common Business Communication Language", in *Textverarbeitung und Bürosysteme*, Albert Endres and Jürgen Reetz, eds., R. Oldenbourg Verlag, Munich and Vienna, 1982.

X12 provides a "meta format" for the documents of commercial transactions. This is a "super form" from which elements may drawn up to define private forms agreed to by pairs of communicating parties. To use X12, two companies must agree on the exact format for various transactions. No serious attempt (à la IP/TCP[34] and ASN.1[35]) has been made to reach universal formats.

Only a few fields of X12 messages are self-defined. X12 is, therefore, sensitive to position errors, such as the omission of empty (aka "blank") fields. X12 does not allow its users to add arbitrary fields as they see fit. For example, an X12 invoice does not have the means to include E-addresses of E-banks for E-payments.

Below is a sample invoice[36] followed by its X12 representation.

```
------------------------------------------------------------------------
ORIGINAL INVOICE                                            PAGE 1 OF 1

cust order no - P989320                                invoice no - 1234567
contract no                                               date  7/13/81
partial order no
order date  6/25/81       cust ref no - 6004F              Remit to
                                                       SMITH CORPORATION
                                                       900 EAST STREET
                                                       BIG CITY, NJ 15455
   Charge to                        Ship to
ACME DISTRIBUTING COMPANY        THE CORNER STORE
P.O.BOX 33327                    601 FIRST STREET
ANYTOWN, NJ 45509                CROSSROADS, MI 48106
                                                     Terms date 7/13/81
                                                     Terms of sale ....
                                                        2% 10TH PROX
                                                     Correspondence to:
                                                       C.D. Jones
                                                       (618)555-8230

      Quantity   Unit   No    Description             Price
         3        CS   6900   CELLULOSE SPONGES       12.75
        12        EA   P450   PLASTIC PAILS             .475
         4        EA   1640Y  YELLOW DISH DRAINER       .94
         1        DZ   2507   6 IN PLASTIC FLOWER POT  3.40

Invoice Total                                          51.11

Shipper 7/14/81          via CONSOLIDATED TRUCK  B/L  28713
========================================================================
```

[34] TCP is the Transmission Control Protocol, used throughout *The Internet* of DARPA and NSF.

[35] ASN.1 is the CCITT standard (X.409) for data types.

[36] This sample invoice and its X12 representation are copied from *"Invoice Transaction Set (810) ANSI X12.2-1986"*, approved February 20, 1986.

The following is its annotated translation into X12.

```
-------------------------------------------------------------------------

(Plain English)  | actual X12
-------------------------------------------------------------------------
It's an invoice  | ST*810*0001
date, inv#, date.| BIG*810713*1234567*810625*P989320
addr of charge to| N1*BT*ACME DISTRIBUTING CO.
                 | N3*P.O.BOX 33327
                 | N4*ANYTOWN*NJ*45509
addr of ship to  | N1*ST*THE CORNER STORE
                 | N3*601 FIRST STREET
                 | N4*CROSSROADS*MI*48106
addr of remit to | N1*SE*SMITH CORPORATION
                 | N3*900 EAST STREET
                 | N4*BIG CITY*NJ*15455
   attn Mr Jones | PER*BU*C.D.Jones*TE*618-555-8230
terms of sale    | ITD*01*03*2**10
item #1          | IT1**3*CS*12.75*VC*CN*6900*FD*CELLULOSE SPONGES
item #2          | IT1**12*EA*.475*VC*CN*P450*FD*PLASTIC PAILS
item #3          | IT1**1*EA*.94*VC*CN*1640Y*FD*YELLOW DISH DRAINER
item #4          | IT1**1*DZ*3.40*VC*CN*2507*FD*6 IN PLASTIC FLOWER POT
shipped via      | CAD*M*****CONSOLIDATED*CC
invoice total    | TDS*51.11
end of invoice   | SE*20*0001
=========================================================================
```

Examination of X12 leads to the conclusion that it was developed as a means to computerize existing manual procedures. Systems designed for computers differ greatly from those that evolve through stepwise computerization of manual systems[37].

X12 is designed to be machine processable, not human-readable. This makes X12 easy to use across language boundaries, but people lacking nontrivial computing capabilities cannot use it.

*E-Commerce* needs both computer/computer and computer/people business communication protocols. Eventually everyone will have local computing power sufficient to reduce the computer/people protocol to a user interface issue. Until then, *E-Commerce* will need a human-readable business communication protocol.

[37] For example: In the old days, when customers asked the bank clerk for their balances, the clerk looked at a paper record (once prepared by hand and then by machines). When computers were introduced, many banks printed all the paper records every night and distributed them to the branches, so that the old procedures could be followed. Finally, the system was redesigned so these inquiries could be answered via online terminals.

It may not be fair to compare X12, which is already in its deployment phase and in use at many organizations every day, to CBCL and other proposals that are still in the paper stage and do not face the realities of actual transactions. Still, we suggest two major directions of development: (1) a business communication protocol based both on McCarthy's ideas and on the X12 experience, and (2) human-readable interfaces to support use of that protocol by individuals, such as home users, with minimal computing capabilities.

### (i) BCP - Business Communication Protocol

Though a BCP is difficult to define without knowing the kind of computerized processing it will support, experience will enable us to do better than X12. Experience has taught us of the need to design for the support of ever-evolving systems and ever-increasing capabilities, for example.

For the benefit of those who have not read McCarthy's paper on CBCL, here are its main characteristics:

(1) CBCL is a common language that can express business communications.

(2) Any organization should be able to communicate with any other without prearrangements.

(3) The system should be open-ended; as programs improve, capabilities can be added.

(4) CBCL is strictly a communication protocol; it presupposes nothing about the programs that use it.

(5) CBCL is not concerned with low-level aspects of message delivery.

(6) CBCL messages are lists of items punctuated by parentheses. The lead item of each list identifies the type of message and is used to determine how to interpret the rest. The items may be either sublists or atoms. If an item is a sublist, its first element tells how to interpret it.

(7) No position should require an identifier or a number *per se* but should allow a phrase.

The following are examples of CBCL:

(REQUEST-QUOTE (YOUR-STOCK-NUMBER A7305) (UNITS 100))

(REQUEST-QUOTE (PENCIL #2) (GROSS 100))

(REQUEST-QUOTE (ADJECTIVE (PENCIL #2) YELLOW) (GROSS 100))

(WE-QUOTE (OUR-STOCK-NUMBER A7305) (QUANTITY 100)
(DELIVERY-DATE 3-10-77) (PRICE 1.00))

Unfortunately, no project was ever established to pursue and implement CBCL as proposed by McCarthy. After McCarthy, we consider BCP a means for communicating business transactions, such as an invoice or a purchase order, represented by self-defined trees.

The unit of BCP is a list. Lists represent trees. List items are constants, lists, and names of predefined procedures or expressions in a language not yet specified. The lead item of each list identifies the type of list and is used to determine how to interpret the rest. The child lists/fields inherit all the attributes of a parent list, unless otherwise specified.

Business transactions may have several ID-numbers, such as RFQ number, quotation number, invoice number, and shipping document number. Each participant may assign not more than one ID-number to a given transaction. It is the job of the application-level program, not of the BCP, to handle and match these identification numbers.

Any communication may be acknowledged positively or negatively and inquired upon at several levels. In this BCP, an invoice, for example, would include a standard transaction header (such as the transaction type [INVOICE here], the originator of the transaction, a transaction identification number assigned by the originator [INVOICE-NUMBER], and the date of the transaction [INVOICE-DATE]).

It might also include information identifying who is credited by this invoice (usually the originator of the invoice, but not necessarily), who is charged (usually the addressee of the invoice, but not necessarily), details about the order (*e.g.,* P/O-number), payment terms, shipping (*e.g.,* when, by whom, shipping document number, and destination), and finally the invoiced items and the total amount of the invoice.

The invoiced items usually include quantity, description, price, and cost (where *cost* = *quantity* × *price*).

The entire invoice can be conceived as a tree with attributes attached to its nodes. Common attributes for several items may be factored out and attached to any node that is above all of them. Example of such common attributes are discount, tax, handling, insurance charges, currency type, and shipping. If all the invoiced items were shipped together, then the shipping information can appear at the top level of the invoice; if they were shipped separately, the shipping information should be distributed among all the items. If the same shipper handled them on different dates, the shipper name can be at the top level of the invoice but the shipping dates must be distributed among the items.

Note that items like *price*, *cost*, and *total amount* can be as simple as numeric values or complex enough to include values, type of currency, and date of conversion to another currency (*e.g.,* the price of gold on the date of delivery). However, checking/verifying the consistency of the fields (*e.g.,* prices, costs, and totals) is **NOT** a function of the BCP, but of the application-level procedures, just as matching P/O, quotations, and invoices are application-level procedures.

Any attribute attached at a lower level overrides any definition of the same attrib. ·s at higher levels. This is useful for exceptions, *e.g.*, one item shipped later than the rest. Other implementation tricks for efficient communication as means to define repeated lists and expressions are available.

Since different organizations upgrade their procedures independently, we should expect some messages to include items that receivers do not understand. In list structure, it is always possible to discard a sublist without being able to parse it[38]. Though many items may be discarded without a major effect, some are absolutely necessary for proper handling of transactions. For example, it is acceptable not to understand and to discard a list that contains information about the kind of truck used for shipping, but it is not acceptable to discard the invoice amount or the type of currency used. Therefore, something should identify items as "*must be understood*".

For any BCP to succeed, it must be universally accepted in a certain format (like IP/TCP and ASN.1) rather than constantly re-invented in pairwise arrangements. Universal acceptance would take some significant effort. It would be easier to develop a BCP if a *generic-UPC* were accepted. The current UPC ("specific-UPC"), so successful and so popular, defines specific products by a specific manufacturer. RFPs and RFQs could use a generic-UPC that defines only the product, and not its manufacturer. Quotations and invoices, on the other hand, should use the specific-UPC[39] once the specific product is identified.

In summary, we expect the BCP to be to *E-Commerce* what $4'\,8\frac{1}{2}''$ was to the transportation infrastructure of the United States[40].

The following is the same invoice as above (slightly modified), in a possible BCP.

[38] This may not be possible if a list must be parsed in order to figure its length.

[39] Universal Product Code, aka "Zebra-Code".

[40] The U.S. standard railroad gauge is $4'\,8\frac{1}{2}''$, with ties $8'6''$ long.

```
(INVOICE
  (INVOICE-BY
    (COMPANY-NAME SMITH CORPORATION)
    (COMPANY-ADDR 900 EAST STREET // BIG CITY, NJ 15455)
    (ATTN C.D. Jones)
    (TEL 618-555-8230)
  )
  (INVOICE-TO
    (COMPANY-NAME ACME DISTRIBUTING COMPANY)
    (COMPANY-ADDR P.O.BOX 33327 // ANYTOWN, NJ 45509)
  )
  (INVOICE-NO 1234567)
  (DATE 7-13-81)
  (ORDER
    (PO-NO P98S320)
    (CUST-REF 6004)
    (DATE 6-25-81)
  )
  (SHIPPING
    (SHIPPED-TO (SAME-AS INVOICE-TO) )
    (SHIPPED-BY (COMPANY-NAME CONSOLIDATED TRUCK) )
    (DATE 7-14-81)
    (SHIPPING-BL 28713)
    (CHARGE 12.21)
  )
  (PAYMENT-DUE (ADD SHIPPING.DATE 30) )
  (ITEM
    (SET
      (ITEM
        (DESCRIPTION CELLULOSE SPONGES)
        (QUANTITY 3)
        (UNIT CS)
        (NO 6900)
        (PRICE 12.75)
      )
      (ITEM
        (DESCRIPTION (UPC 9753102468) )
        (QUANTITY 12)
        (UNIT EA)
        (NO P450)
        (PRICE
          (VALUE 3.00)
          (CURRENCY FRENCH-FRANC)
        )
      )
      (ITEM xxxxxx)
      (ITEM xxxxxx)
    )
  )
  (TOTAL 51.11)
)
```

### (ii) X12H - Human-readable BCP

We suggest development of a human-readable format for business communication. This is probably best done by developing translators between that human-readable format and the BCP (be it X12, CBCL, or any other). The conversion from BCP to X12H is much simpler than the conversion from X12H to BCP because of problems similar to those of natural-language understanding, which might require human help to resolve ambiguities.

X12H should be

* Both human readable and machine processable.
* Self defining to support extensibility.
* Flexible, with emphasis on unordered sets.
* Forgiving of obvious mistakes (but should use a certain measure of verification upon correction of nontrivial errors).
* Accepting of unambiguous popular common conventions (*e.g.,* date, time, and two-dimensional formats), including cases that do not comply with the above.

"Dec-2-88", "2 December 1988", "December 2 1988", "December 2d, 1988", and "December 2nd, 88"are different but unambiguous conventions for the same date, probably the date of the list (unless otherwise specified). There is no need to insist either on a specific format (such as "881202" or "12/2/88") or on the inclusion of some "date-field-identifier".

X12H, like the BCP, should be totally independent of the way it is transported (*e.g.,* X.400, Internet-Mail, MCI-Mail, and Telemail).

In X12H, it should be perfectly acceptable to start a document with "INVOICE" (or even with "I N V O I C E"), rather than with "TYPE=INVOICE" or "(TYPE INVOICE)".

For ease of human readability, the fields and lists of the formal BCP should be encapsulated in the informal line structure (multi-line entities, such as addresses, should get special attention). Only when absolutely necessary should a computer-like hierarchy of parenthesis (including "begin"/"start" and "end", pairs of "( )", "[ ]", "{ }", "< >", and nesting) be used.

X12H should make common-sense default assumptions. It should assume, for example, that the currency is US$ in the United States and that the unlabeled date at the top of a document is probably the date of the entire document. X12H should handle two-dimensional constructs, common in addresses, and two-dimensional tables defined by labels in the first row (as in the sample invoice on the previous page).

Users will likely provide to X12H their *user profiles* to indicate defaults (*e.g.,* language and currency) and their preferred style (*e.g.,* of date format).

In short, X12H should have as much common sense as we are able to give it.

## 14. The Unified E-Marketplace (or lack of it)

We have raised many examples of application areas for the various forms of *E-Commerce*, including purchase of interchangeable objects, E-invoicing, and E-payments. Now we'll turn to systems that provide various forms of *E-Commerce*: Prodigy, the Source, and the E-banking offered by CitiBank in the East and Bank of America in the West.

There are many more *E-Commerce* systems in the U.S., such as TRANSNET[41], Aetna's GEMINI (interconnecting their agents), IVANS (Insurance Value Added Network Service), and GE's GEIS. They use a variety of protocols, from X12 to private protocols, typically for specific domains such as UCS (for groceries) and TRANSNET. In addition, billions of dollars routinely move between financial institutions using various forms of EFT.

We find it most unfortunate that these systems have developed independently rather than as part of a unified E-marketplace. It is easy to get software for E-banking services from any of several banks, but difficult to get programs that can talk simultaneously to several different banks. It seems that the mistake made by commercial suppliers of E-mail in the U.S. has been repeated in the E-marketplace.

It is not that there are no standards; on the contrary, there are too many of them, and that may be worse than none.

This Tower of Babel exists for two reasons. First, E-marketplaces are developed independently, without coordination among the different domains and with no thought of compromising in order to gain interoperability even before the need for it is apparent. Second, suppliers in the same domain (*e.g.*, E-banking) are aware of one another but try to capture clients by giving them special software to handle their unique, incompatible protocols. This short-term strategy is doomed in the long run, as has been proven time and again in many domains (remember Xerox's Interpress?).

A unified E-marketplace should be appealing and easy to join for both suppliers and users. By joining the unified E-marketplace, one should be able to reach everyone else in the E-marketplace by complying with one protocol suite and possibly by using the same software, in the same environment. This would attract more buyers/sellers than would the need to buy separate hardware and software in order to deal with the various sellers/buyers.

A unified E-marketplace should become a national (and international) infrastructure on the order of transportation, commerce, and communication. Attempts to build isolated services would disregard lessons of the past and have but a slim chance to succeed economically.

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[41] TRANSNET was created by the Motor and Equipment Manufacturers Association (MEMA) to communicate purchase orders electronically. In 1987, it carried orders from 450 customer locations to 100 manufacturers, for a total value of 70M$. It serves mostly automobile manufacturers, the auto-aftermarket, and a few electronic parts distributors and their suppliers.

Growth will make the unified E-marketplace attractive and accelerate its own growth. The more sellers that participate, the more attractive it will be to buyers. The more buyers on the system, the more attractive it will be to sellers. New services will become available as soon as the demand for them is recognized. The E-marketplace would benefit from the existence of an E-payment infrastructure, coupled with E-authentication and E-signature infrastructures.

## 15. Conclusion

*E-Commerce* has great potential to modernize and accelerate many commercial transactions, of both goods and information. This will reduce both the cost and the time required for prototyping and for manufacturing and will foster competition in industry. However, in spite of the many advantages of *E-Commerce*, it is very difficult to break the *chicken and egg* curse and computerize commerce.

We believe that *E-Commerce* will not succeed as a revolution, but as a slow evolution consisting of many steps, including E-mail, computer communication, and E-payments. Any of them, and many more, must be developed on their own economic merits and as components of a unified system that assures their eventual interoperation.

*E-Commerce* will have its greatest impact when it is integrated with the internal computers of participating organizations. Intra-organizational computerization and inter-organizational communication must be tied together in an infrastructure that includes both universally accepted Business Communication Protocols and universal and ubiquitous computer communication networks[42].

True *E-Commerce* should be based on open and public protocols and data interchange formats designed for computer/computer communication, rather than for computers talking to dumb terminals. Only with a universally accepted business communication protocol can the E-marketplace ever be truly unified.

*E-Commerce* in the country is rapidly splintering. The longer we wait before starting to unify *E-Commerce*, the more difficult unification will become.

Some relatively small investments are needed now to accelerate the glacial pace of *E-Commerce*. The entire system must be designed; interchange formats must be established and promoted, and the required infrastructure must be seeded.

Though the entire country - government, business, and individuals – will benefit from the advance of *E-Commerce*, only the government is in a position to make that investment.

The purpose of this report is to stir interest and to stimulate ideas about *E-Commerce*. Toward those ends, one final thought: the success of *E-Commerce* does not rest on technology alone. Social, economic, and legal issues are part of the equation, and they should be factored in from the beginning.

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[42] ISDN (CCITT's Integrated Services Digital Network), if it ever gets to be as popular as hoped, may provide universal and ubiquitous computer communication capabilities, giving millions of customers (even at home) access to the computer communication networks used by large organizations.

## 16. Acknowledgments

The term *Computerized Commerce* was coined by Ivan E. Sutherland in his acceptance speech for the 1975 Award for Outstanding Accomplishment of the Systems, Man, and Cybernetics Society.

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[⋈]

## Appendix A: E-Stamps

*This appendix, a slight digression from the main course of the report, assumes familiarity with packet-switching technology. It is included as an example of an online payment scheme.*

Today, we communicate online mainly by phone and FAX and offline by mail.

We pay for the online communication through pre-arranged billing agreements that resemble credit cards.

We pay as we go for offline communication on a cash basis, without prior arrangements with the postal services (including, to a certain extent, UPS, Federal Express, DHL, and Emery[1]). Stamps cover the cost of the requested transaction, depending on Type-of-Service [2] (or TOS), distance, weight, and additional services (if any) such as a Return Receipt Request[3].

We have complete control over our offline communication expenditures, because the entire cost of each transaction is determined *before* it is completed, and because we decide who gets the stamps. We have less control over online communication expenditures, because the entire cost of each transaction is determined only *after* it is entered and because we cannot control who uses our phones and how they are used.

In most organizations, any employee can initiate overseas phone calls that exceed his phone budget. He cannot affix to a letter more stamps that he physically has.

The postal service handles each offline transaction independently of any other transaction by the same organization. However, organizations are charged centrally for all online transactions initiated by any employee. The phone companies use hierarchical billing structures; the postal service uses a flat one. (Incidentally, many large organizations gain better control by restricting certain phones and by using charge-numbers for every call, but not without great expense.)

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[1] United Parcel Service (UPS) is the most popular package delivery service in the United States, more popular even than the similar service offered by the postal services of the U.S. government. Federal Express, DHL, and Emery are private services that specialize in fast delivery of letters and small packages.

[2] The *Type-of-Service* (TOS) is the specification of the required service. It is analogous to services such as telegrams, overnight deliveries, and second-class mail.

[3] One may argue that the postal system operates on prepayment, which takes place when you buy stamps or "load" a postal meter, not on pay-as-you-go. The difference is insignificant, because unused stamps are refundable.

Both the postal services and the phone companies sell billing services. The postal services call it COD[4], and the phone companies call it 976[5].

It is no wonder that billing and accounting cost the postal services less than they cost phone companies.

Payment for network services is another story.

First, there are public data networks (PDN) open to the public, and private networks available only to members of certain exclusive clubs. Typically, private organizations own the public networks (*e.g.,* TELENET), while the public owns many private networks through, for example, NSF and DoE[6].

Second, the U.S. government's private networks typically do not charge their users for services. These networks are paid for by public funds. All of the public networks charge for their services, because they are owned by private organizations. Their billing is similar to the phone companies' (albeit with less detail, typically) in the sense that it is done per connection, after the fact, hierarchically.

Even though postal billing has many advantages, it is never considered for networks because of the impracticality of "putting stamps" on bits in transit.

The phone companies base their charges on connections, similar to the basic mode of service offered by the public networks. On the other hand, the postal services base their charges on packages, similar to the basic mode of packet service offered by many private networks.

If packet (not connection!) based networks are to implement billing, should they adopt an approach similar to the one used by the phone companies, or one like that of the postal services? Because connectionless packet communication resembles the shipping of packages, we propose the latter.

Let's assume first that we have reached the era of accepted public key encryption systems and a financial infrastructure supporting electronic transactions.

For simplicity, assume that E-checks[7] based on public keys are used as E-stamps and that hardware can perform the required en/decryption quickly. Thus, E-stamps can be implemented as records that are included in the headers of messages given by hosts (gateways, *etc.*) to networks and to other resources.

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[4] COD means "Cash On Delivery". It allows sellers to send packages and have the payment collected upon delivery at the destination.

[5] In the U.S., a recent service that allows various vendors to collect a fee of about $2 for calls made to them, in addition to the charge for the call itself. It happens that most of these are sex-related calls.

[6] The U.S. National Science Foundation and the U.S. Department of Energy.

[7] See Section 5 on E-payments.

If the requested transaction requires more than one resource – say, a regional, a long-haul, and a remote regional network – each of these resources can be paid by (a) a separate E-stamp for each resource (like airline tickets), or by (b) giving the total payment to the first resource who, upon transfer to the next resource, replaces that E-stamp with another that reflects the balance of payment after subtracting the fee for the first resource. Similarly, each resource collects its fee by replacing the E-stamp with another of lesser value. Under this scheme, users need not know how much each resource charges; they need only know the total charge for the service.

We prefer the latter as a standard approach, without precluding separate E-stamps for some services, according to various protocols.

We hope that the various networks would arrange for certain free service messages, such as "Insufficient E-Stamps", "Wrong Address", and messages needed to determine the cost of communication.

Call-in telephone directory information used to be free; it may still be free in some locales, but not for long-distance inquiries. Even though long-distance information may be provided free, local carriers typically charge for accessing it. The same may or may not happen with network name servers.

When E-stamps are implemented, maintainers of certain databases may request E-payment, in advance, for their services. FTP[8] servers may request the same before responding to a remote user's request to retrieve a file.

Once payment is required for each delivery, junk mailers may think twice before sending junk electronic mail (J-mail) to hundreds and thousands of recipients. The reduction of J-mail alone is a strong motivation for pursuing E-stamps.

We expect many new for-pay services to be offered over networks. They will include direct orders from supermarkets and catalog houses, the existing *FAST*[9] service, travel services (including ticketing), "yellow pages", engineering services, tax preparation and other accounting services, library searches and document retrieval, education, advertisement, and entertainment, to name a few.

E-stamps should be seriously considered for online payments.

[8] The *File Transfer Protocol* used throughout the Internet of DARPA and NSF.

[9] See Section 12 on *FAST*.

## Appendix B: Package-Switching Technology

*This appendix digresses even further than Appendix A from the main course of the report. It also assumes familiarity with packet-switching technology.*

Imagine a future in which packet-switching communication is truly ubiquitous and universal. Imagine a multi-level hierarchy of networks, including both local ones, such as those inside an apartment, office building, or campus, and long-haul networks for cross-country and intercontinental traffic. Implementation of a proper addressing scheme allows any subscriber to send packets to any other subscriber of this truly global communication system.

Traffic distribution is such that more communication is local than remote, per subscriber. In most cases, local communications (*intra*-site) outnumber external (*inter*-site) communication.

Subscribers pay for the system. They are charged according to the services they use, on the basis of, for example, volume, speed, distance, time of day, and level of guarantee. No single entity owns the entire system. Different authorities (*e.g.*, network owners and operators) may have different schedules of services and prices.

The key to the success of such a system is the interoperability agreement. An agreement must cover everything from pricing and billing to interfaces and protocols.

There are many approaches to universal addressing. The scheme itself – IP, CCITT#7, X.121, the addressing of the postal services, or whatever — is not important. It is important only to agree on a certain universal addressing scheme.

For efficiency, it may be necessary to aggregate packets (as the phone carriers and the postal services do, although IP does not). A hierarchy of aggregation (packaging) would be defined to match the hierarchy of networks and channels (such as DS0, T1, and T3). The following is an example of such a hierarchy:

Let the service be defined for packets of size $S = H + D$, where $H$ is the size of the "header" and $D$ is the size of the data, the payload to be actually delivered to the destination. By definition, the header includes *all* the necessary information for getting packets to their destinations according to parameters requested by the senders. This information may include payment and billing information in addition to address, priority, and Type-Of-Service.

$S$, $H$, and $D$ are defined for each level of networking. For example, $S_0 = H_0 + D_0$, at level-0. (The question of handling packets smaller than the agreed upon $D$ is left for future agreements.)

$N_1$ packets of $L_0$ (level-0 networks) may be aggregated to form an $L_1$-packet.

Hence, $D_1 = N_1 * S_0 = N_1 * (H_0 + D_0)$.

In general: $S_n = H_n + D_n = H_n + N_n * S_{n-1} = H_n + N_n * (H_{n-1} + D_{n-1})$.

For example, in telephone data applications over DS0, connections use $H_0 = 1bit$, $D_0 = 7bit$. The next level, DS1 (aka T1), is constructed by $N_1 = 24$ in the U.S. (in Europe $N_1 = 32$) and $H_1 = 1bit$. Hence $S_1 = 1 + 24 * (1 + 7) = 193bits$, and its efficiency (defined as the ratio of total user data to the total size of the message) is $24 * 7/193 = 87\%$.

Subscribers are permitted to use packets of any one level without using any lower or higher levels. Certain subscribers may use only $L_1$-packets that cannot be decomposed into smaller $L_0$-packets. However, their packets may be multiplexed (*e.g.,* by the network operators) into higher level packets.

This scheme has no intrinsic highest level, although there is always a highest level for which services are defined and implemented.

Similarly, no lowest level is needed. One could extend the definition below $L_0$, by defining $N_0, D_{-1}$, and $H_{-1}$. This could be extended downward as far as practical and useful. (Notice the similarity to the concept behind the ISO definition of paper sizes, $A_0, A_1, A_2, \ldots$ ).

The logic behind the selection of packets for aggregation is part of the general network architecture and is therefore not discussed here.

The *end-to-end* protocols, as used by the hosts (the subscribers' computers), are outside the networks. The job of the network is to carry a packet from its source and make it available to its destination, under the terms (*e.g.,* delay and integrity) of payment. What the destination does with the packet after receiving it is not the business of the network.

Many kinds of interesting networks follow the above description. Telephone and data communication are just two familiar examples.

When packet-switching technology is applied to three-dimensional packets it becomes the new Package-Switching Technology, discussed in the rest of this section.

*WARNING: The rest of this appendix digresses even further from the main course of the report. The busy reader, who is not interested in far-out, semi-serious ideas, should skip it.*

Consider packages of size $S_3 = (1' \times 1' \times 3')$ with $N_4 = (2 \times 2 \times 3)$ and $H_4 = (2' \times 2' \times 2'')$. Hence $D_4 = (2' \times 2' \times 9')$ and $S_4 = (2' \times 2' \times 9'2'')$.

In one interesting mechanical design for the $L_3$-packages, 12 of them can be combined into $L_4$-packages without additional width and height overhead, and length penalty of only $2''$. The header information of $L_3$ and $L_4$ may be, for example, printed in a circular UPC[1] and posted on the outside of the packages for easy machine readability while the package is in motion.

We are open to suggestions on the format for other levels. It would be nice if some standard size would fit the established standard for $40'$-containers, because so many billions of dollars have already been invested all over the world in the infrastructure (ships, trucks, trains, cranes, *etc.*) for handling these containers across land and sea.

Packages smaller than $L_3$ may serve intra-office communications (like the pneumatic tubes in old post offices) for transportation of items such as books, coffee, and supplies. The $L_3$-packages may be useful for more substantial transportation jobs, such as groceries and laundry.

It should be possible to find several ways for a package of given size to combine smaller ones or be combined into larger ones.

In the early stage of development, $L_3$-terminals will be in every house, apartment, and office (especially in newly built areas), but only big complexes will initially have $L_4$-terminals. At first, only a few of them may have fast services as required for moving people, but with time this service will expand in popularity.

With time, this service will become more automated and computerized, and more transportation facilities will be added. Initially, it could be a mix of transportation technologies such as automatic pneumatic carts for local deliveries, combined with trucks, trains, and aircraft for longer distances. Fully automated warehouses could serve as store-&-forward switches, used for optimizing the aggregation and re-aggregation of packages.

It will take many years to create the fully automated transportation network for these packages. Local systems will be developed first (*e.g., intra*-organization, -building, -campus) and later interconnected via automated *inter*-system facilities. Until then, local systems will be connected via "manual" systems, such as trucks, trains, ships, and aircraft. For smooth transition, the $\{L_i\}$ system should be chosen to fit existing container standards (*e.g.,* "igloos" for aircraft, and $20'$ and $40'$ containers for ships, trains, and trucks).

[1] Universal Product Code, aka "Zebra-Code".

The long-haul transportation (say, from the West Coast to across the Rockies) will handle large packages at high speed and volume. Each will contain a multitude of packages of lower levels. The job of switches will be to assemble, disassemble, reassemble, and route these containers so as to optimize transport of all packages.

The design of the computerized switches is left as an exercise for engineering-minded readers. Issues such as flow control, guarantee of service, delay control, and so on are well understood and should be easily dealt with. In performing this design exercise, feel free to borrow ideas from computer networks, automated airline baggage-handling systems, and train systems.

*Hint*: You have to worry about lost packages, but not about duplicates.

The development of such a transportation infrastructure would require a national effort in areas such as electronics, mechanics, pneumatics, hydraulics, electric rail-guns, and medicine, to name just a few.

The vision of a world with trees and flowers replacing old roads, a world in which we would never have to go shopping (unless we wanted to), is so appealing that we must pursue it with our best engineering and scientific talent!

*<End of Digression.>*

[⋈]